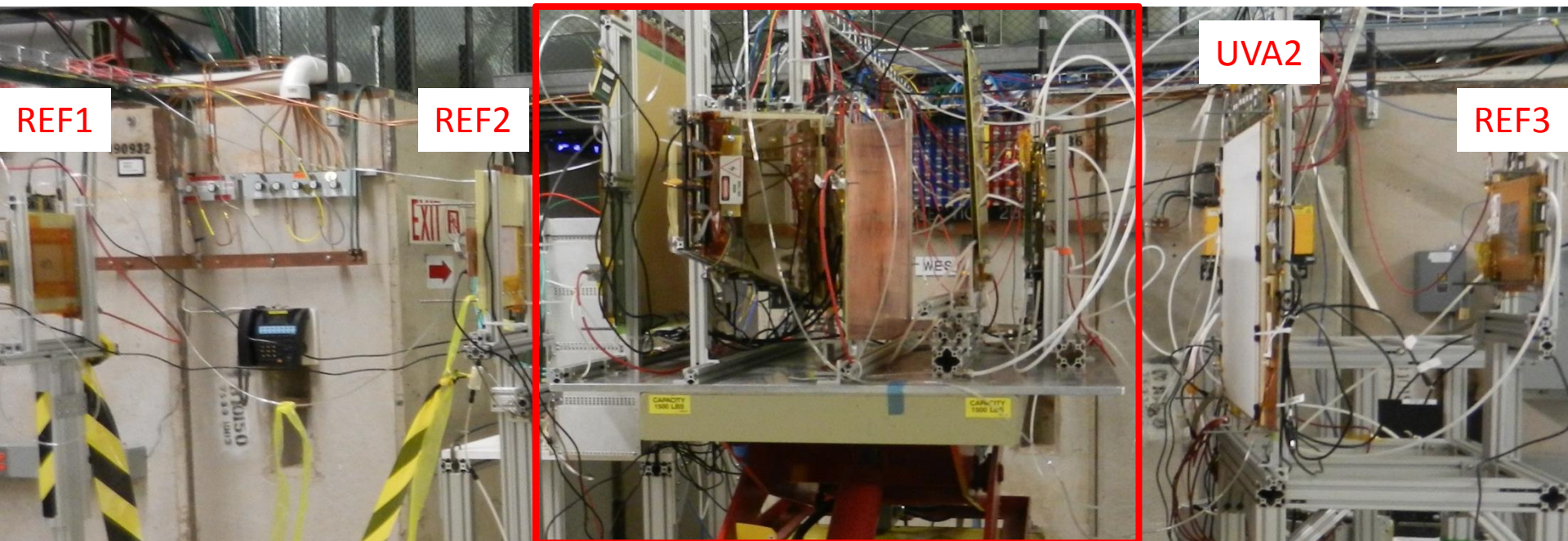


Update on residuals studies

Kondo Gnanvo

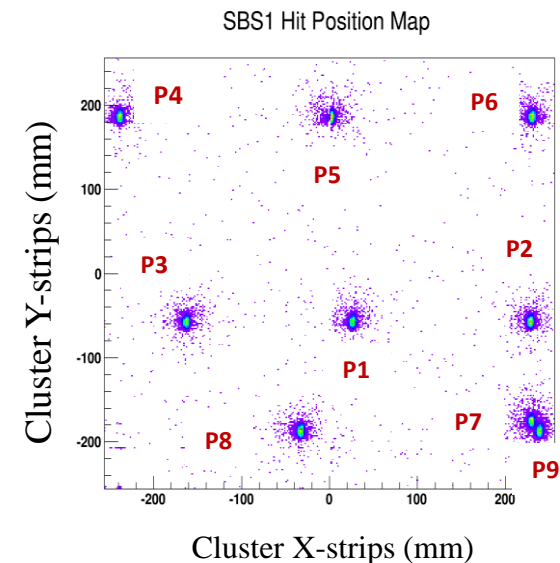
EIC Weekly meeting, Dec. 08, 2014

FTBF: Florida Tech & UVa Setup



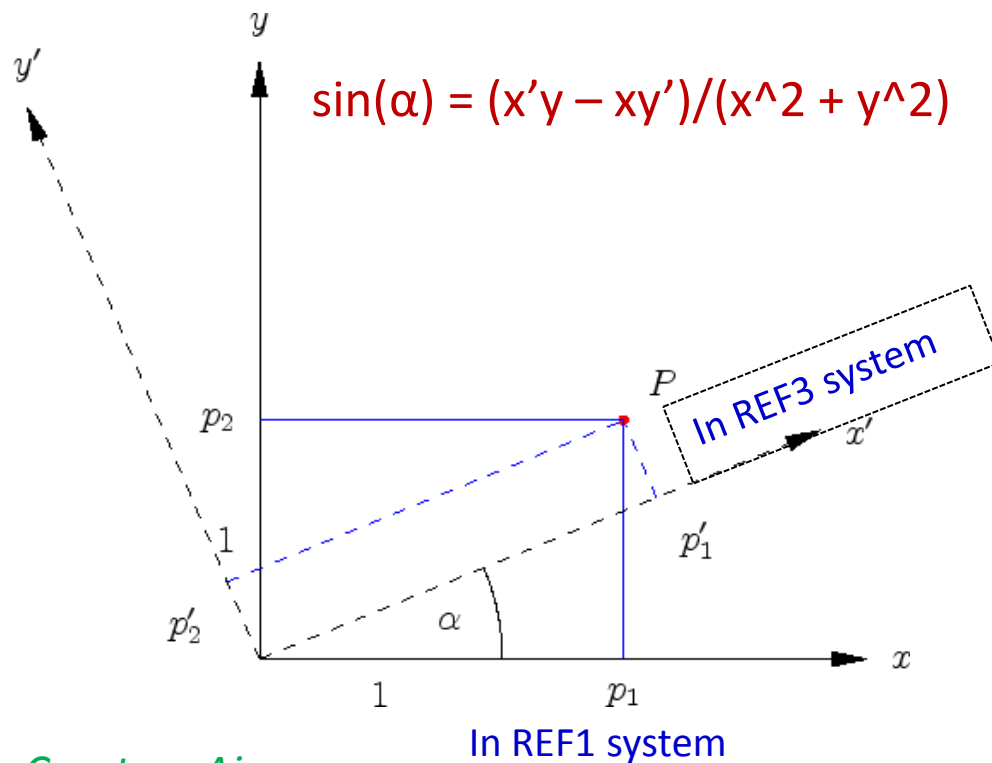
Detectors on the moving table

- Reference trackers REF1, REF2, UVA2 & REF3 are all in fixed position during the whole FTBF campaign
- All other detectors including SBS1, UVa EIC and Florida Tech EIC, 30x30 and two small ZZ GEM are on the moving table



Calculation of the XY-Plane rotation w.r.t tracker REF1

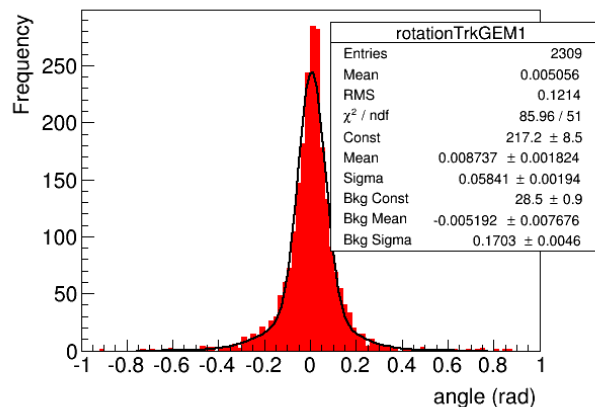
- Consider only rotation in XY plane (around Z). Assume REF2 (the first ref. detector) is not rotated.
- If detectors are fully aligned, the two coordinate systems have same origin in XY plane.
- So the rotation angle α is calculated. In the formula, (x,y) are from REF2, (x',y') from REF3
- Angles from 120GeV proton data.



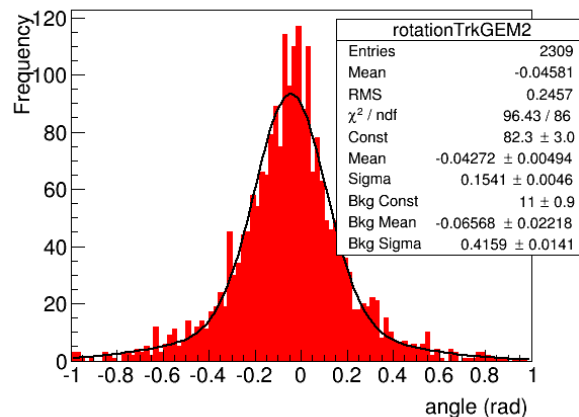
Courtesy Aiwu

XY-Plane rotation angle from 120 GeV proton beam data

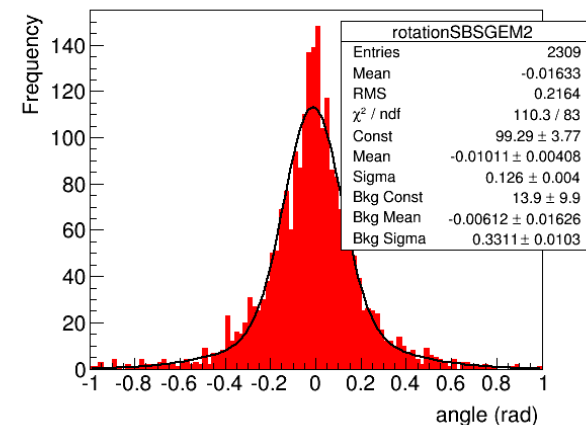
REF1 – REF2



REF1 – REF3



REF1 – UVA3



REF1-REF2

REF1-REF3

REF1-UVA3

FIT angle

4 mrad

-48.5 mrad

-17.35 mrad

UVa mean angle from histogram

5.06 mrad

- 45.8 mrad

-16.33 mrad

UVa mean angle from Double Gaussian fit

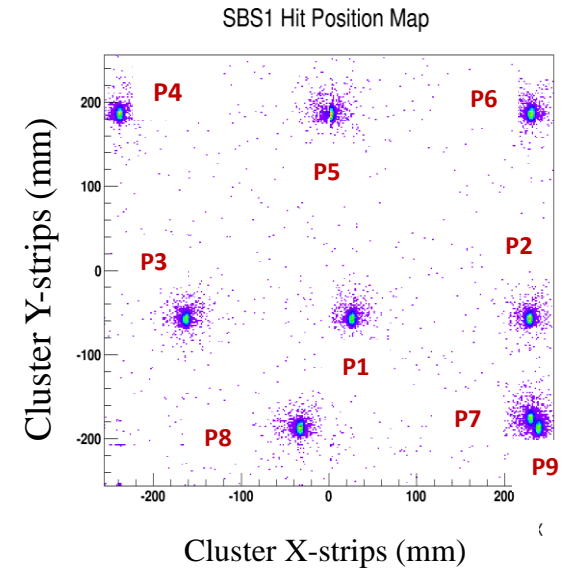
8.74 mrad

-42.7 mrad

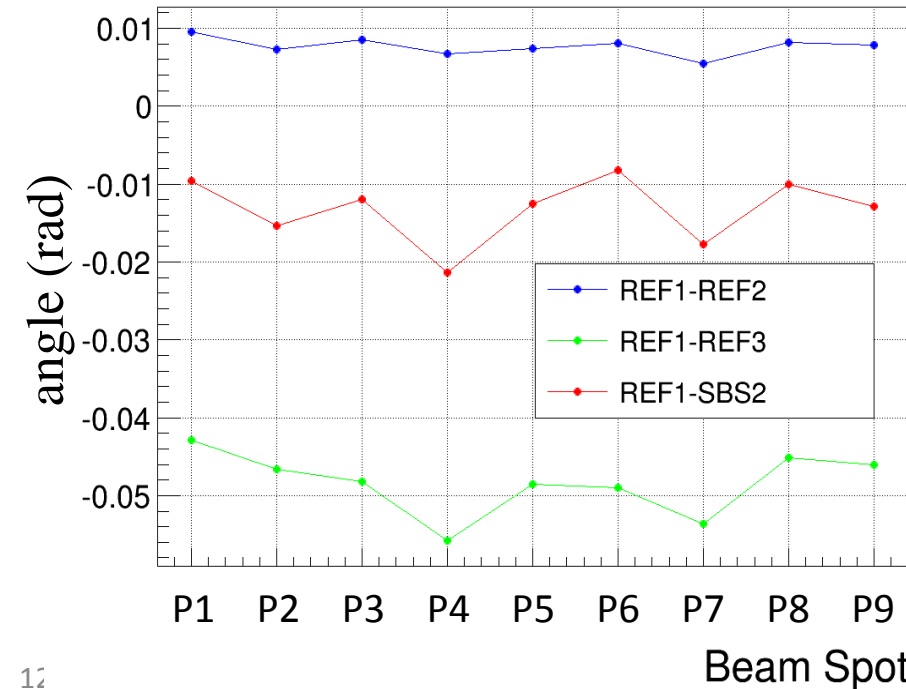
-10.11 mrad

XY-plane rotation angle correction for the trackers for various run

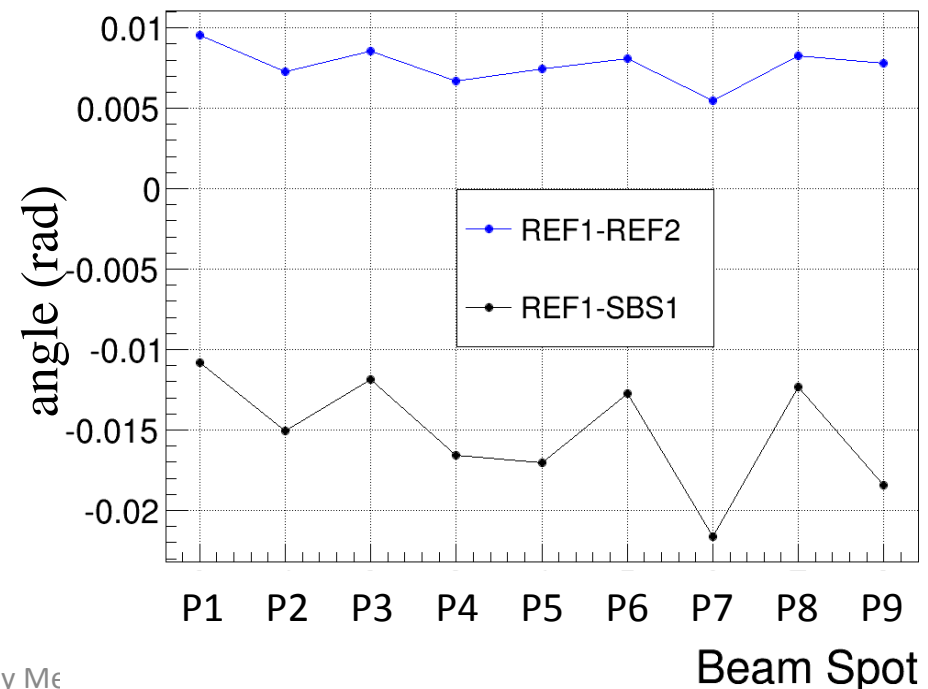
- Spot location P1 to P9 refers to the position scan on SBS1
- The trackers and SBS2 are fixed → expect no variation of the angle from one run to the other Small variation between REF1 and REF2
- Big variation between REF1 and REF3 as well as REF1 and SBS2
- Amplitude of the variation is < 5 mrad and as high as 15 mrad for REF3 and SBS2



XY-Plane rotation angle



XY-Plane rotation angle

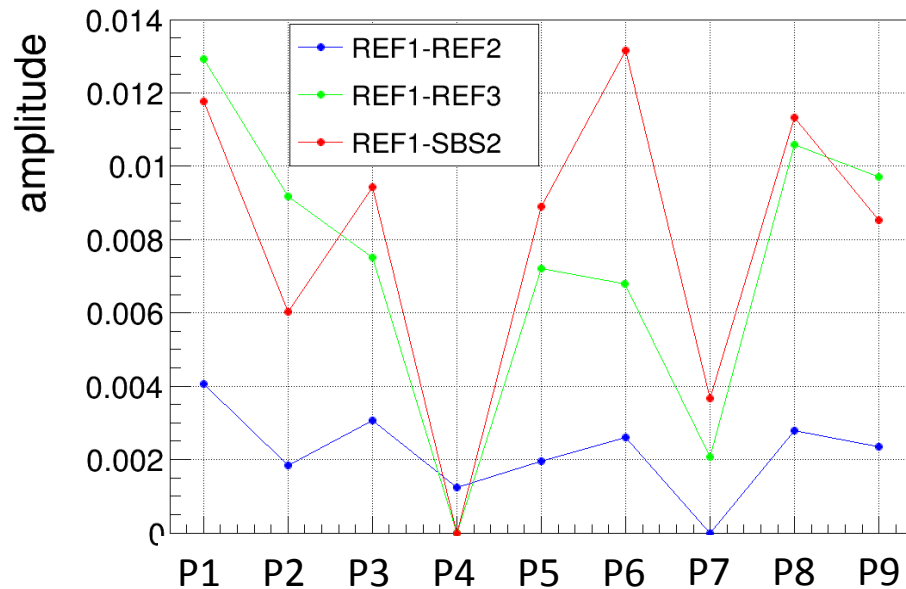


Amplitude of rotation angle: SBS1 vs. Trackers for various run

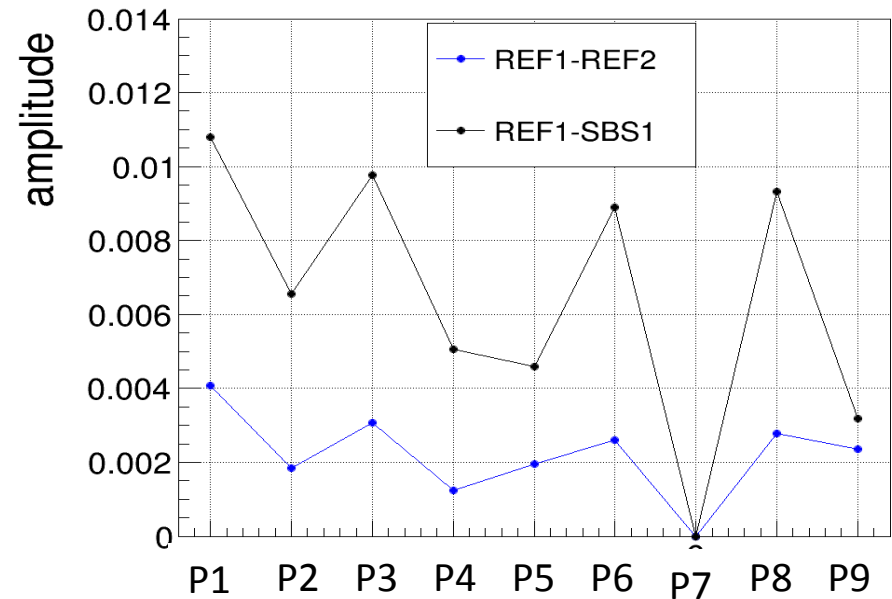
- Amplitude variation of the rotation angle for SBS2 and REF3 are higher than for SBS1
- SBS2 and REF3: Multiple Coulomb Scattering explain the significant variations
- SBS1: Variation of the rotation angle from misalignment caused by the moving table and bending of the readout plane with the gas pressure (we observed) but no multiple scattering

$$\text{amplitude} = \alpha - \alpha_{\min}$$

Amplitude XY-Plane rotation angle

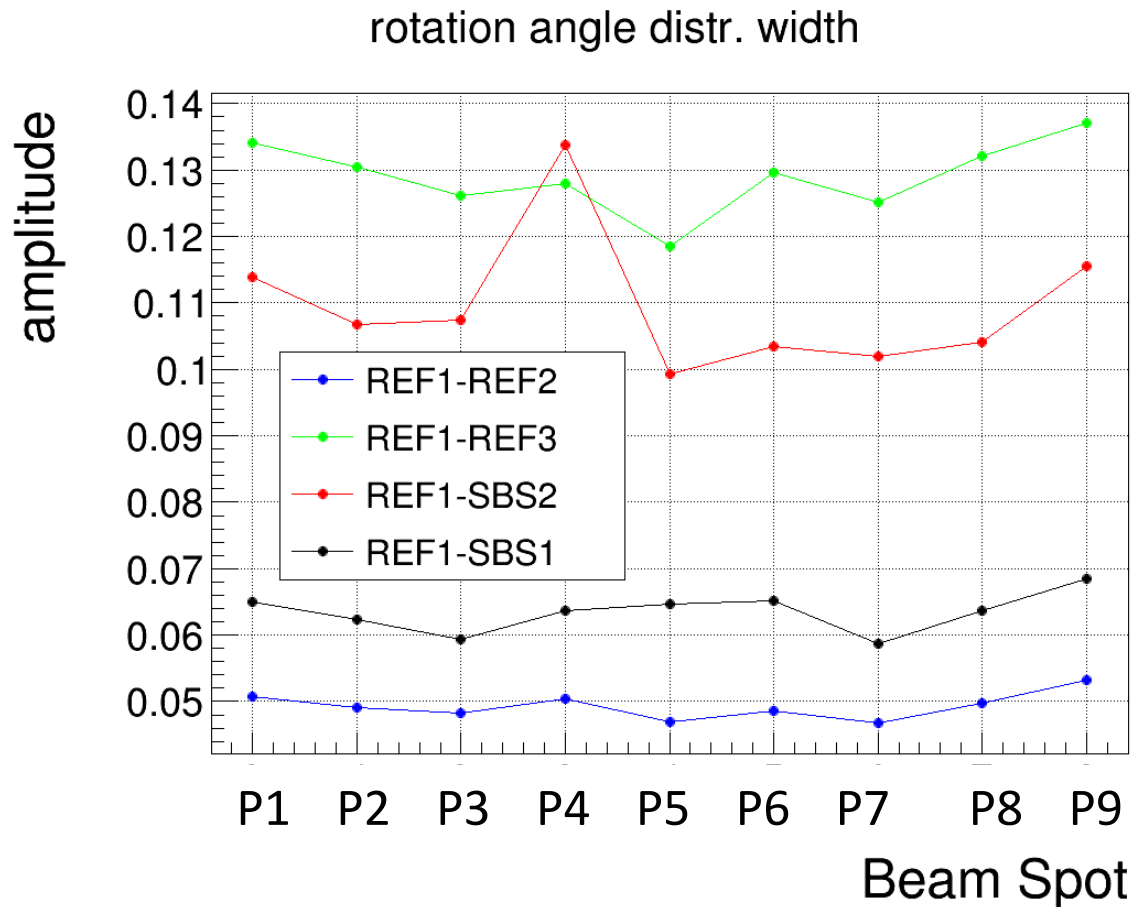


Amplitude XY-Plane rotation angle



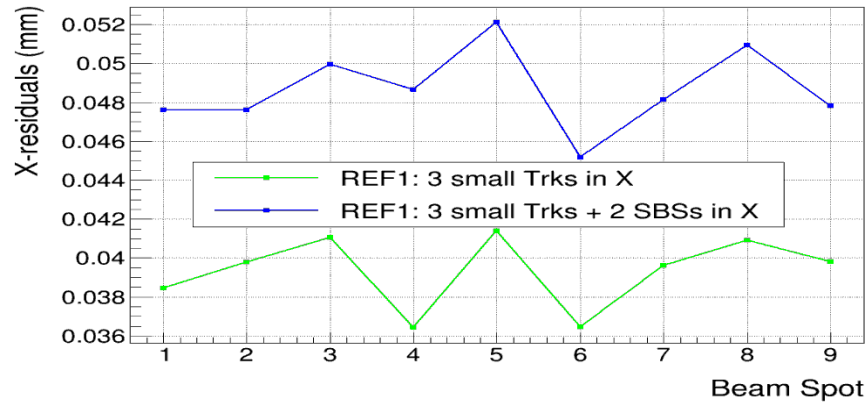
Width of rotation angle for all detectors for various run

- Width of the distribution of the rotation angle w.r.t. to REF1 for all other detectors
- Small value for SBS1 and REF2 and small variation vs run
- Higher values for SBS2 and REF3 and bigger variation for various runs
- Looks like we are seen the effect of the multiple scattering again

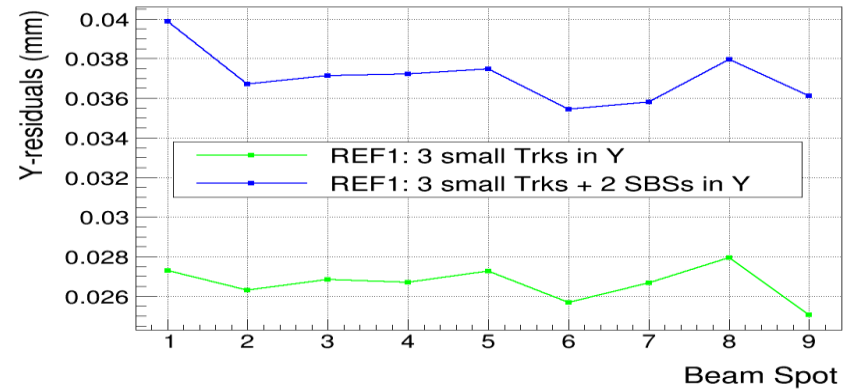


Residuals on the Trackers

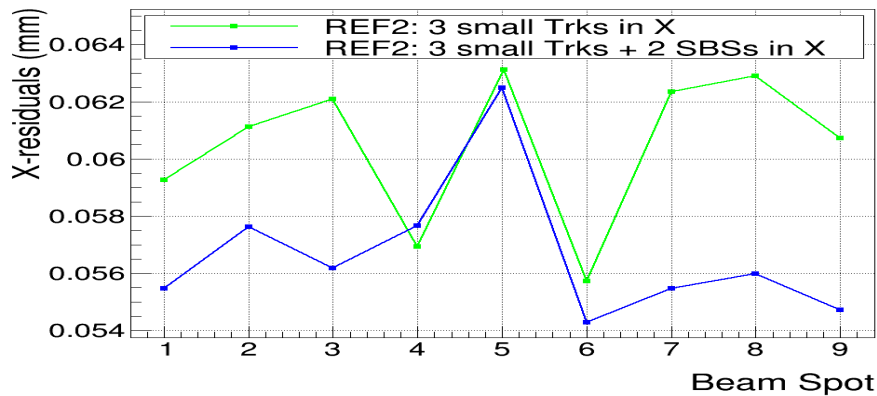
X Residuals vs.beam Spot



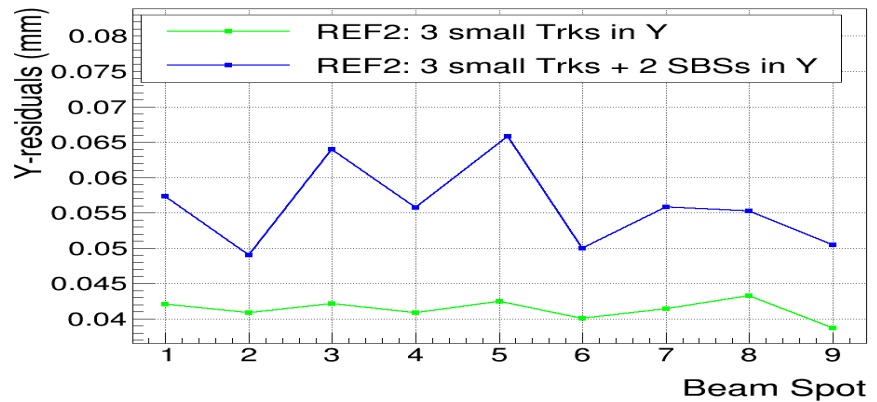
Y Residuals vs.beam Spot



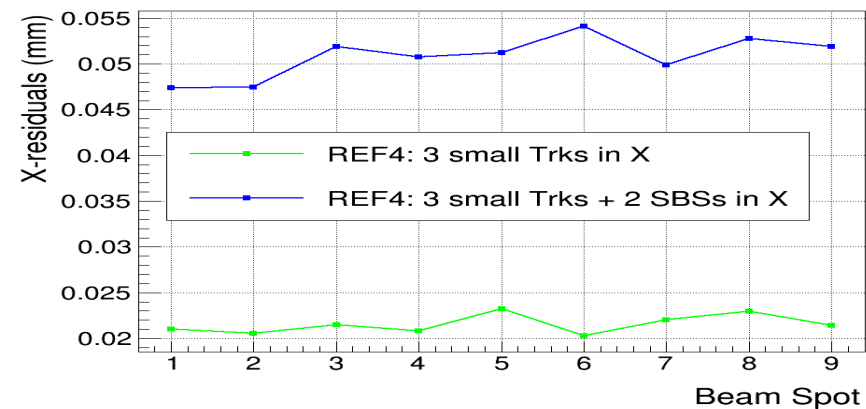
X Residuals vs.beam Spot



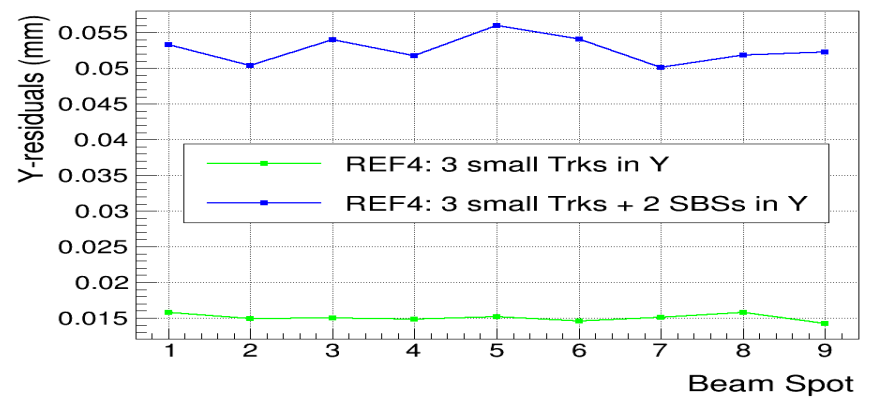
Y Residuals vs.beam Spot



X Residuals vs.beam Spot

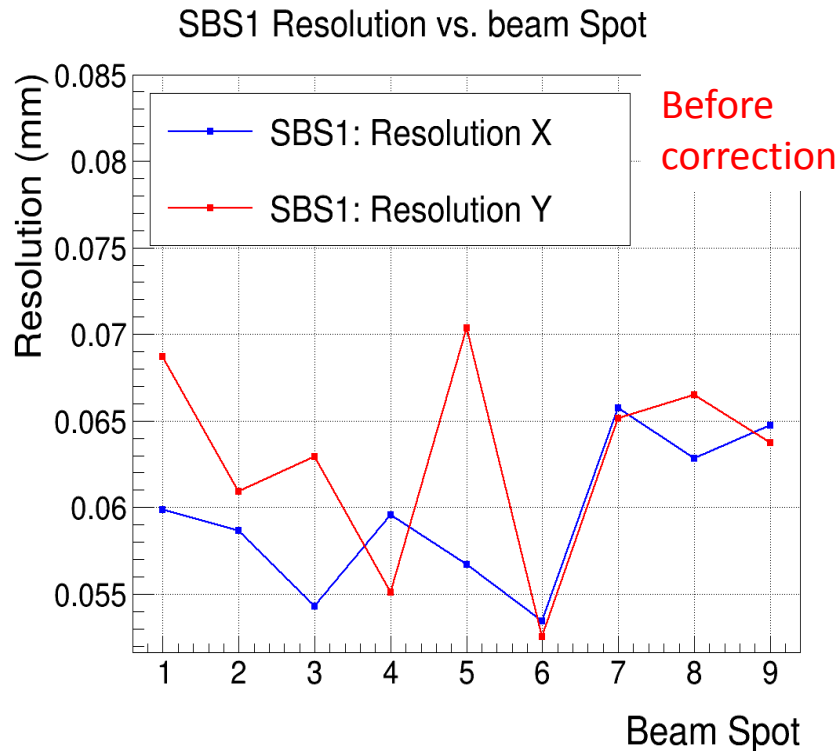
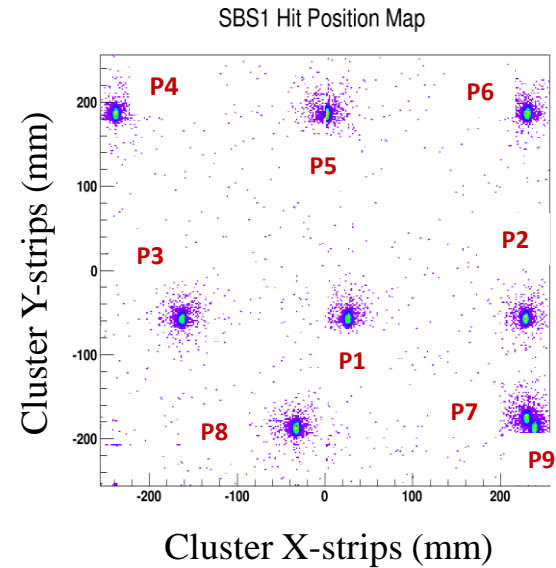


Y Residuals vs.beam Spot



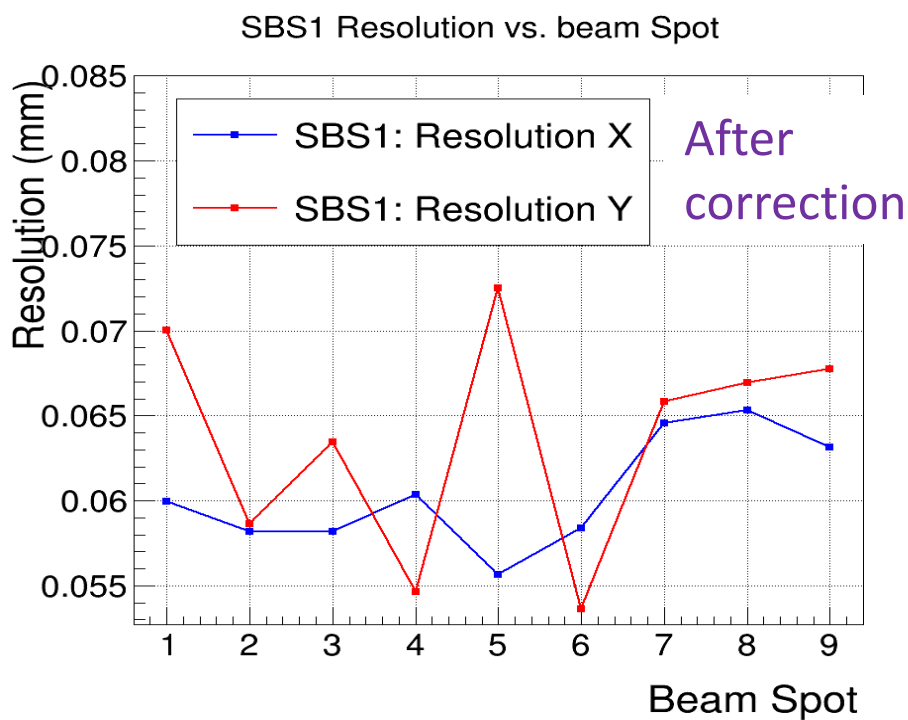
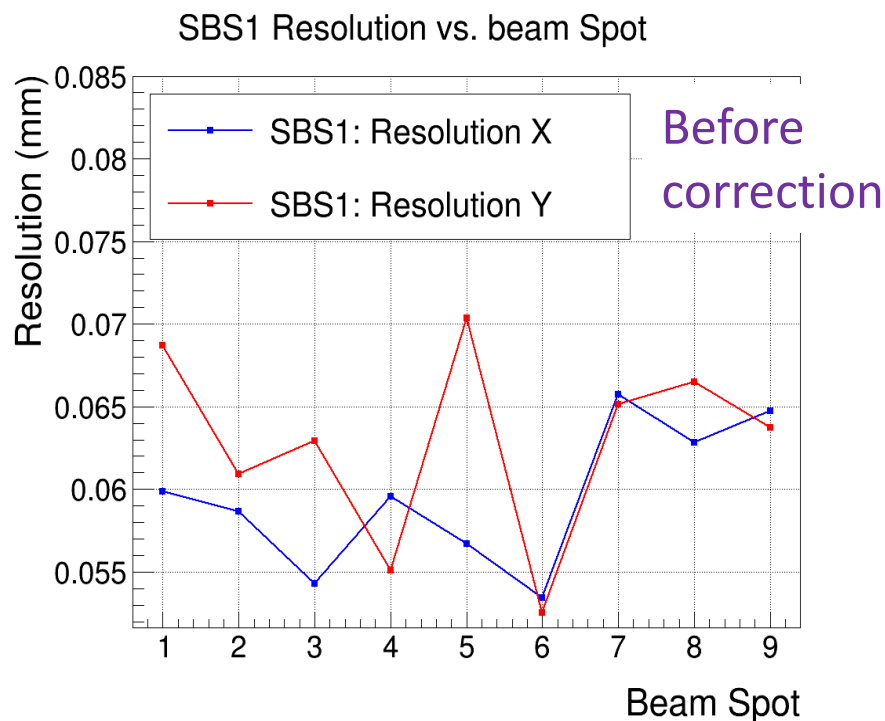
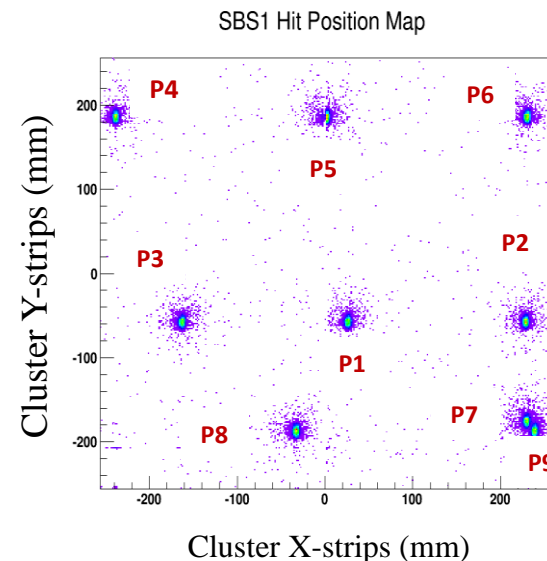
Resolution of SBS1 before and after average angle correction

- Rotation angle for each detector is average over the 9 scanned position and used for the residuals
- Track fit with only REF1, REF2, REF3
- Limited improvement for P1 to P5 for both X and Y
- Significant degradation for P6 to P9 for both X and Y



Resolution of SBS1 before and after point by point angle correction

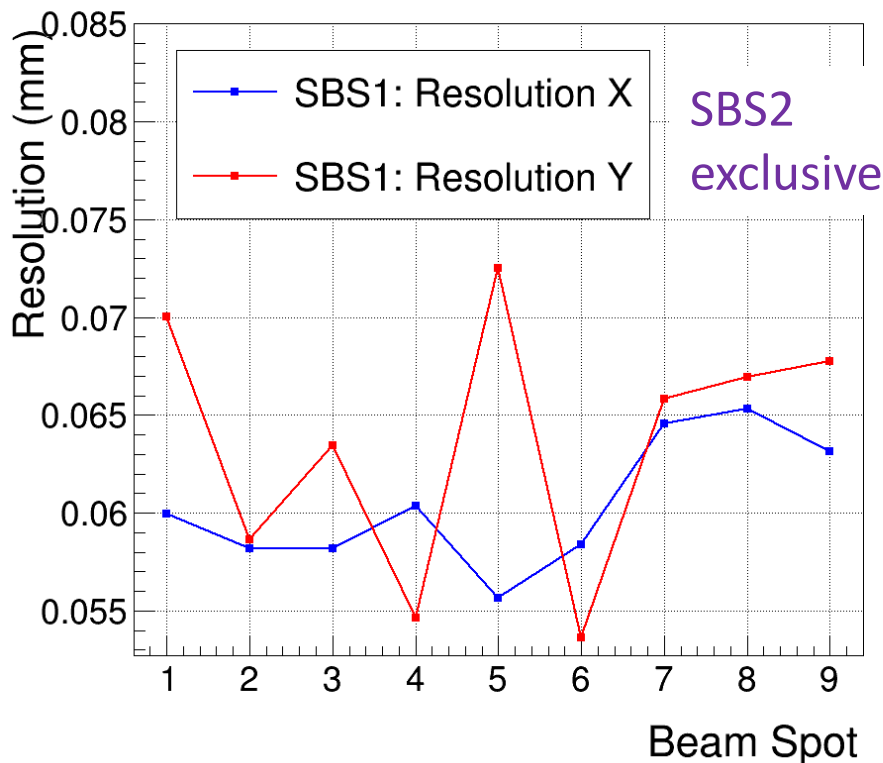
- The rotation angle correction associated to each run (beam spot on SBS1), for each detector is used for the residual analysis
- Track fit with only REF1, REF2, REF3
- No improvement but no real degradation → resolution is marginally worse but not in a significant way



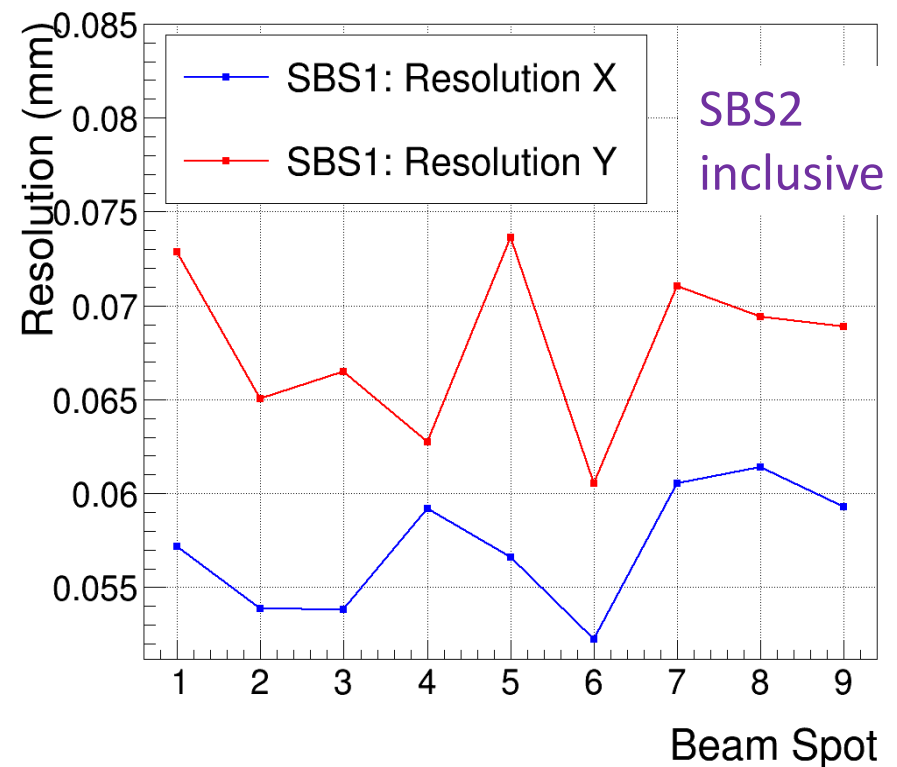
Resolution of SBS1 vs. inclusive and exclusive SBS2

- Variation on SBS2 and REF3 are even higher than for SBS1
- **SBS1**: Expect variation of the rotation angle from misalignment caused by the moving table and bending of the readout plane with the gas pressure (we observed) but no effect from multiple scattering
- **SBS2 (and REF3)**: Don't expect any effects of moving table on the rotation angle. Only MCS can explain the significant variations

SBS1 Resolution vs. beam Spot



SBS1 Resolution vs. beam Spot



Summary

- Study of the impact of the XY plane rotation correction on the resolution of trackers and SBS1
- Big improvement on the trackers residuals, limited impact on the resolution of the SBS1 trackers
- Effect of the Multiple Coulomb Scattering observed on the resolution at different location on SBS1 chamber
- Need to investigate a little bit more and to compare results with both Florida Tech and the GENT4 simulation